

## CLAIMS

We claim:

1 1. A method of prevention sulfidation of metals comprising the steps of:  
2 adding to a fluid including a sulfiding compound an effective amount of a  
3 preventative composition, where the composition reduces or prevents sulfidation by  
4 deactivating metal sites involved in the formation of atomic sulfur and/or sulfides at or on  
5 a surface of the metal.

1 2. A method of stopping sulfidation of metals comprising the steps of:  
2 adding to a fluid including a sulfiding compound an effective amount of a  
3 preventative composition, where the composition stops or arrests further sulfidation of the  
4 metal by deactivating metal sites involved in the formation of atomic sulfur and/or sulfides  
5 at or on a surface of the metal.

1 3. A metal surface treated with a composition comprising an effective amount of a  
2 preventative composition in the presence of a sulfiding agent, where the composition and  
3 sulfiding agent react with metal surface to form a coating which reduces or prevents  
4 sulfidation by deactivating metal sites involved in the formation of atomic sulfur or sulfides  
5 at or on a surface of the metal.

1 4. An apparatus comprising:  
2 a reservoir containing a sulfidation preventative composition and  
3 an introduction system in fluid communication with the reservoir and an interior of  
4 a container having metal surfaces in contact with a fluid including a sulfiding compound,  
5 where the system introduces an effective amount of the composition into the container to  
6 reduce or prevent sulfidation of a surface of the metal.

1 5. The method, surface or apparatus of claims 1-4, wherein the composition comprises  
2 a compound having a higher affinity for the metal surface than the sulfiding compound.

1 6. The method, surface or apparatus of claims 1-4, wherein the composition comprises  
2 an effective amount of a phosphorus in the form of a phosphorus-containing compound to  
3 reduce sulfidation of the metal.

1 7. The method, surface or apparatus of claims 1-4, wherein the effective amount of the  
2 phosphorus is between about 0.001 ppm and about 20 ppm in the fluid.

1 8. The method, surface or apparatus of claim 7, wherein the effective amount of the  
2 phosphorus is between about 0.01 ppm and about 10 ppm in the fluid.

1 9. The method, surface or apparatus of claim 8, wherein the effective amount of the  
2 phosphorus is between about 0.1 ppm and about 5 ppm in the fluid.

1 10. The method, surface or apparatus of claim 8, wherein the effective amount of the  
2 phosphorus is between about 0.1 ppm to about 2 ppm.

1 11. The method, surface or apparatus of claim 8, wherein the effective amount of the  
2 phosphorus is between about 0.1 ppm and about 1 ppm

1 12. The method, surface or apparatus of claim 8, wherein the effective amount of the  
2 phosphorus is between about 0.2 ppm and about 0.8 ppm.

1 13. The method, surface or apparatus of claim 8, wherein the phosphorus-containing  
2 compound comprises phosphorus, phosphines of formulas  $\text{PH}_3$ ,  $\text{PRH}_2$ ,  $\text{PR}_2\text{H}$ , and  $\text{R}_3\text{P}$  where  
3 each R is the same or different and is a C1 to C20 carbon-containing group including alkyl,

aryl, alkaryl or aralkyl; , phosphites including ammonium phosphites; alkali metal phosphites; alkaline metal phosphites; phosphites having organic counter ions; phosphates including ammonium phosphates; alkali metal phosphates; alkaline metal phosphates; phosphates having organic counter ions; pyrophosphates including ammonium pyrophosphates; alkali metal pyrophosphates; alkaline metal pyrophosphates; pyrophosphates having organic counter ions; polyphosphates including ammonium polyphosphates; alkali metal polyphosphates; alkaline metal polyphosphates; polyphosphates having organic counter ions; thiophosphates; thiophosphites; or other phosphorus-containing compounds capable of inhibiting sulfuric corrosion of metal surfaces, or mixtures or combinations thereof.

14. A method of pre-treating metal surfaces comprising the steps of:

contacting a metal surface with an effective amount of a pre-treating composition sufficient to deposit onto the metal surface a protective coating, where the coating prevents or reduces sulfidation of the metal by deactivating metal sites involved in the formation of atomic sulfur and/or sulfides at or on the surface.

15. The method claim 14, wherein the pre-treating composition comprises an organo-phosphorus compound and the method further comprising the step of:

oxidizing the organo-phosphorus compound to a phosphorus oxide compound.

16. The method claim 14, wherein the composition comprises a compound having a higher affinity for the metal surface than the sulfiding compound.

17. The method claims 14, wherein the composition comprises an effective amount of phosphorus in the form of a phosphorus-containing compound.

18. The method claims 14, wherein the effective amount of the phosphorus is between about 0.1 ppm and about 5 ppm in the fluid.

19. The method claims 14, wherein the effective amount of the phosphorus is between about 0.2 ppm and about 0.8 ppm.

20. The method claims 14, wherein the phosphorus-containing compound comprises phosphorus, phosphines of formulas  $\text{PH}_3$ ,  $\text{PRH}_2$ ,  $\text{PR}_2\text{H}$ , and  $\text{R}_3\text{P}$  where each R is the same or different and is a C1 to C20 carbon-containing group including alkyl, aryl, alkaryl or aralkyl; phosphites including ammonium phosphites; alkali metal phosphites; alkaline metal phosphites; phosphites having organic counter ions; phosphates including ammonium phosphates; alkali metal phosphates; alkaline metal phosphates; phosphates having organic counter ions; pyrophosphates including ammonium pyrophosphates; alkali metal pyrophosphates; alkaline metal pyrophosphates; pyrophosphates having organic counter ions; polyphosphates including ammonium polyphosphates; alkali metal polyphosphates; alkaline metal polyphosphates; polyphosphates having organic counter ions; thiophosphates; thiophosphites; or other phosphorus-containing compounds capable of inhibiting sulfuric corrosion of metal surfaces, or mixtures or combinations thereof.